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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/241,695	02/02/1999	AKIHARU MIYANAGA	SEL123	9049

7590 05/31/2002

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EXAMINER
HU, SHOUXIANG

ART UNIT	PAPER NUMBER
2811	

DATE MAILED: 05/31/2002

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No. 09/241,695	Applicant(s) MIYANAGA ET AL.
	Examiner Shouxiang Hu	Art Unit 2811

-- The MAILING DATE of this communication appears on th cover sh t with th correspond nce address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☐ Responsive to communication(s) filed on *22 February 2002* .

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1,3,5-13,15-48 and 50-55* is/are pending in the application.

4a) Of the above claim(s) *5-13,16,17,19,20,22,23,25,26,35-41 and 50-55* is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☐ Claim(s) *1,3,15,18,21,24,27-34 and 42-48* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☒ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

11)☐ The proposed drawing correction filed on _____ is: a)☐ approved b)☐ disapproved by the Examiner.

If approved, corrected drawings are required in reply to this Office action.

12)☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

13)☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☒ All b)☐ Some * c)☐ None of:

1.☒ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____ .

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

14)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).

a) ☐ The translation of the foreign language provisional application has been received.

15)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____ .
4) ☐ Interview Summary (PTO-413) Paper No(s). _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other:

DETAILED ACTION

Claim Objections

1. Claims 1, 3, 15, 18, 21, 24, 27-34 and 42-48 are objected to because of the following informalities/defects:

Each of claims 1, 29 and 42 defines the second impurity being injected along the <110> direction and then redefines the second impurity being injected along the diagonal direction, but fails to clarify what is the correlation between the recited <110> direction and the recited diagonal direction.

Appropriate correction is required.

Claim Rejections - 35 USC § 103

2. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

3. Claims 1, 3, 15, 18, 21, 24, 27-34 and 42-48 are rejected under 35 U.S.C. 103(a) as being unpatentable over Chang et al. ("Chang"; 5,893,740) in view of Ko et al. ("Ko"; 5,686,321) and/or Mikoshiba (JP 56060061 A).

Chang discloses a semiconductor IC device (Figs. 1-3), comprising MOSFETs and each of the MOSFETs comprises: source and drain regions with a first impurity; a

channel forming region between the source and drain regions and an impurity region (18 or 28; a punchthrough stop region) being added with a second impurity having an opposite conductive type to the source and drain regions and being formed under the channel forming region.

Although Chang dos not explicitly discloses that the concentration of the second impurity in the channel forming region is from 1/100 to 1/10 of that in the impurity region, one of ordinary skill in the art would readily recognize that the impurity concentrations of the channel forming regions and the punchthrough stop region are well recognized parameters of importance subject to routine experimentation and optimization; and that a channel forming region can normally have a doping concentration of $5x10^{16}$ /cm^3 through $1x10^{17}$ /cm^3 and a punchthrough stopper region can normally have a doping concentration of $1x10^{18}$ /cm^3 through $1x10^{19}$ /cm^3, for effectively prevent punchthrough, as evidenced in Ko. Ko teaches (Fig. 1-4; and see col. 4, lines 11) that it is desirable to form the channel forming region (63) with a doping concentration range that covers $5x10^{16}$ /cm^3 through $1x10^{17}$ /cm^3 and to form the punchthrough stopper region (24) with a doping concentration range that covers $1x10^{18}$ /cm^3 through $1x10^{19}$ /cm^3, which covers a concentration ratio that is between 1/100 and 1/10.

In addition, it is noted that, as illustrated by the arrow direction shown in Fig. 3C, the second impurity for the punchthrough stop region in Chang is injected along a direction of substantially about 45 ± 3 degrees to the vertical; and that the exact injection direction is a well recognized parameter of importance subject to routine experimentation and optimization. Although Chang does not expressly disclose that the

channel is oriented along a <100> direction, one of ordinary skill in the art would also readily recognize that the channel in a MOSFET can be desirably aligned to a <100> crystal direction on a wafer parallel to a (100) crystal plane for minimizing the adverse piezo effect, as evidenced in Mikoshiba (Fig. 1), which compress a gate (5) aligned along a {100} direction on a (100) substrate.

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to make the semiconductor device of Chang with the second impurity for being injected along a direction of about 45 $\pm$ 3 degrees to the vertical, with the concentration of the impurity in the channel forming region being from 1/100 to 1/10 of that in the impurity region and with the channel being aligned to a <100> crystal direction on a wafer parallel to a (100) crystal plane, as taught in Ko and/or Mikoshiba, so that a device with faster switch speed, increased punchthrough voltage and minimized piezo effect would be achieved. And, in such a device taught by Chang in view of Ko and/or Mikoshiba, since the injection direction is about 45-degrees to the vertical and the channel is aligned along a <100> direction, the second impurity injection direction would be inherently along a <110> direction, which would then be inherently perpendicular to a plane having the smallest atomic density of the semiconductor substrate.

Regarding claim 29, Chang's semiconductor device further comprises a pair of LDD region (14).

Regarding claims 18, 21, 24, 29-33 and 44-47, it is noted that it is old and well known in the art that semiconductor devices having MOSFETs with short channels can be used in microprocessors, including RISC or ASIC ones, and can be applied in cellular phones, personal handy phone systems and portable computers. Therefore, it would have been obvious to one having ordinary skill in the art at the time the invention was made to make the semiconductor device and apply it to the above areas for achieving improved performance/cost combination in these areas.

Regarding claim 27, 34 and 48, Chang further discloses that the peak impurity region is formed at a depth of from 50 to 60 nm (Col. 3, lines 58 and 59).

Regarding claim 28, it is noted that Chang's MOSFET is a bulk one on silicon substrate; and, a bulk MOSFET is normally formed with a single crystal substrate.

Regarding claims 42 and 43, it is noted that Chang discloses that the device can be a COMS (col. 5, lines 1-10) and that Ar, P and B are all well known doping impurities for making a MOSFET or a CMOS.

Response to Arguments

4. Applicant's arguments filed on 2/22/02 have been fully considered but they are not persuasive.

Applicant's main arguments include: Mikoshiba does not teach the second impurity being injected along <110> direction; and neither Mikoshiba nor Chang teaches reducing the damage in the impurity introducing step or reviewing the influence on the

crystal lattice, and the ion implantation is a vertical direction in Ko. In response, it is noted that one cannot show nonobviousness by attacking references individually where the rejections are based on combinations of references. See *In re Keller*, 642 F.2d 413, 208 USPQ 871 (CCPA 1981); *In re Merck & Co.,* 800 F.2d 1091, 231 USPQ 375 (Fed. Cir. 1986); and that the fact that applicant has recognized another advantage which would flow naturally from following the suggestion of the prior art cannot be the basis for patentability when the differences would otherwise be obvious. See *Ex parte Obiaya*, 227 USPQ 58, 60 (Bd. Pat. App. & Inter. 1985). In this case, Mikoshiba is relied on in the above claim rejections for showing that the <100> direction is a well known desirable direction for the channel length orientation, as it has the advantage of minimizing the adverse piezo effect, regardless whether or not it teaches the second impurity being injected along <110> direction. And, as stated in the above claim rejections, the second impurity in Chang is injected along a direction of substantially about 45 ± 3 degrees to the vertical, and the exact injection direction is a well recognized parameter of importance subject to routine experimentation and optimization. Accordingly, in the device taught by Chang in view of Ko and/or Mikoshiba, the injection direction would be inherently parallel to the <110> direction, since the injection direction would be about 45-degrees to the vertical and the channel length would be aligned along a <100> direction. Furthermore, with the second impurity being injected along the <110> direction, injection direction would then be inherently

perpendicular to a plane having the smallest atomic density of the semiconductor substrate.

In addition, Ko is relied on in the above claim rejections for showing that the claimed impurity concentrations of the channel forming regions and the punchthrough stop region and the concentration ratio thereof are well within the commonly recognized normal ranges in the art, regardless whether the second impurity is injected along a vertical direction or the <110> direction, as one of ordinary skill in the art would readily recognize that the functionality of a channel punchthrough stop region is always strongly correlated with such impurity concentrations and concentration ratio, no matter which direction the second impurity is injected along.

Conclusion

5. Papers related to this application may be submitted to Technology center (TC) 2800 by facsimile transmission. Papers should be faxed to TC 2800 via the TC 2800 Fax center located in Crystal Plaza 4, room 4-C23. The faxing of such papers must conform with the notice published in the Official Gazette, 1096 OG 30 (November 15, 1989). The Group 2811 Fax Center number is (703) 308-7722 or 308-7724. The Group 2811 Fax Center is to be used only for papers related to Group 2811 applications.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to ***Shouxiang Hu*** whose telephone number is **(703) 306-**

5729. The examiner can normally be reached on Monday through Thursday from 7:30 AM to 6:00 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, ***Tom Thomas***, can be reached on **(703) 308-2772**. The appropriate fax phone number for the organization where this application or proceeding is assigned is **(703) 308-7724**.

Any inquiry of a general nature or relating to the status of this application should be directed to the **Technology Center Receptionists** whose telephone number is **(703) 308-0956**.

Shouxiang Hu
May 28, 2002